

## **Attachment 1**

### **Characterization of Potential Salt Cavern Disposal Sites**

# Attachment 1

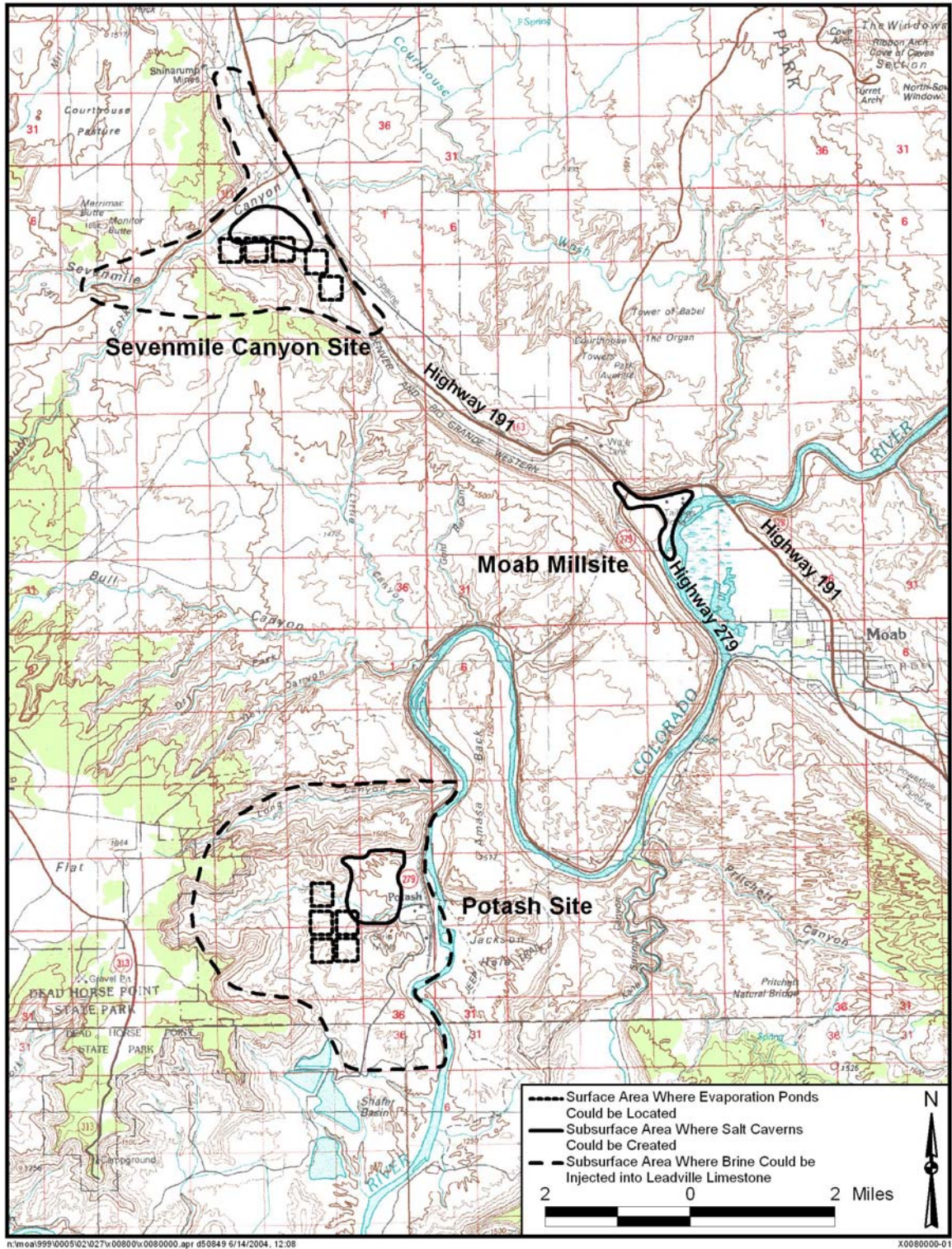


Figure 1. Location Map of Three Geologically Potential Sites

## **Attachment 1**

### **Description of the Moab Millsite**

The thick Paradox Formation composing the Moab Valley salt diapir beneath the Moab millsite might provide solution-mined caverns for tailings disposal. Original beds in the Paradox Formation have been disturbed by salt flowage during creation of the salt diapir. Because of this, beds in the Paradox Formation below the site are expected to be highly contorted or indistinct, or both. This salt flowage and its creation of indistinct or contorted beds in the formation is analogous to conditions in salt domes along the U.S. Gulf of Mexico coastal area, where numerous solution-mined caverns have been developed for storage of liquid and gas products but never for radioactive waste.

The thickness of the Paradox Formation decreases from southwest to northeast across the project site (Figures 2 and 3). At the southwest end of the site (Figure 3), the formation thickness is estimated at 6,000 to 7,000 feet and at the northeast end of the site along the Colorado River; the formation thickness may reach up to 9,000 feet. The northwest-striking Moab normal fault (Figure 3) with a displacement of approximately 2,500 feet is in the northwest end of the site; a larger thickness of the Paradox Formation is on the southwest, or upthrown, side of the fault. The Moab Fault disappears to the southeast, in the area northeast and east of the tailings pile, in the main part of the thick diapir forming the Moab Valley salt-cored anticline.

Multiple solution-mined caverns at the Moab millsite would potentially be situated in an arc-shaped area starting east of the tailings pile and extending north and northwest near State Highway 279 (Figure 2). Spacing of approximately 1,000 feet between each cavern would allow enough area for six caverns. The top of each cavern would be at depths of between 2,000 and 3,000 feet. In the northwest part of the millsite, approximately 1,000 feet of bedrock overlying the Paradox Formation occurs southwest of the Moab Fault. In the southeast part of the millsite (and in all locations), approximately 500 feet of cap rock, the insoluble residue on top of the leached salt diapir, occurs at the top of the Paradox Formation. With these conditions, the base of the 2,000-foot-high caverns would be at depths of between 4,000 and 5,000 feet across the millsite.

Brine disposal at the Moab millsite could be achieved by deep well injection into the Leadville Limestone or sent to large multiple evaporation ponds. The Leadville is approximately 400 feet thick in this area and at a depth below the effects of salt movement. The estimated depths to Leadville Limestone vary across the Moab millsite from 8,000 feet at the northwest end of the site to 9,000 to 10,000 feet in the southeast part of the site. However, the surface area at the Moab site is sufficiently large to allow only one or two brine injection wells. These injection wells would be used for disposal of brine contaminated with fine-grained mill tailings or contaminated ground water. The majority of brine solutions from cavern development could be disposed of by deep well injection into the Leadville Limestone at the potash site or the Sevenmile Canyon site or by evaporation in large evaporation ponds up to 500 acres in size.



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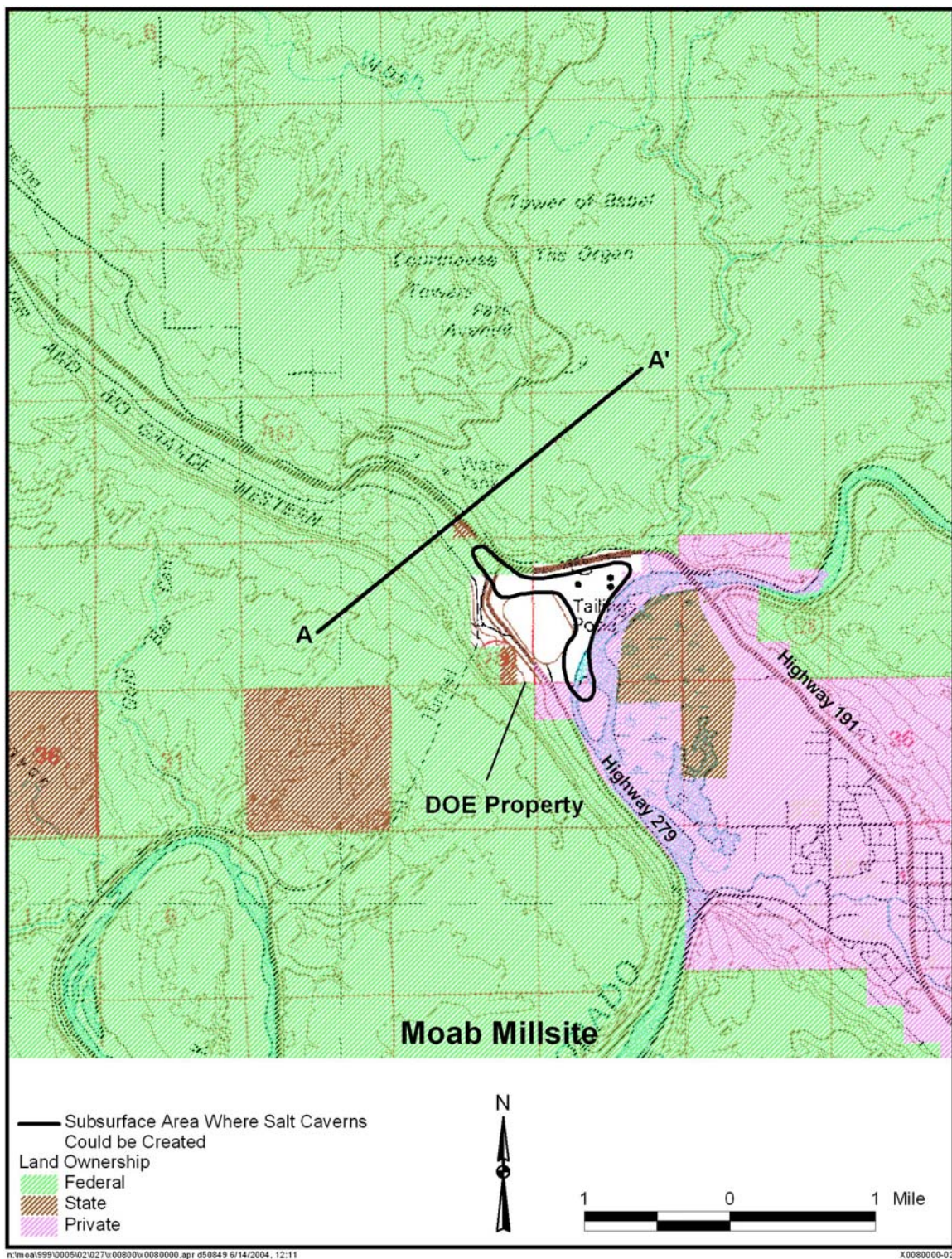
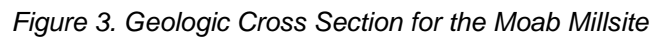


Figure 2. Property Ownership and Location of the Geologic Cross Section for the Moab Millsite



## **Attachment 1**

### **Description of the Potash Site**

The thick Paradox Formation underlying the Intrepid potash site could provide solution-mined caverns for tailings disposal. The proposed disposal area under which the caverns could be situated is on the northeast flank of the northwest-striking Cane Creek Anticline (Figure 4) approximately 6 air miles southwest of the Moab millsite. This area is about 0.5 to 1 mile north to northwest of the offices and loading facilities of Intrepid Mining, LLC, the present solution-mining and evaporation operator at the Intrepid potash site. Also, the area is at least 0.5 mile north of the underground potash mine workings.

Road distance from the Moab millsite to the potash site along State Highway 279, which is mostly along the bank of the Colorado River, is 15.4 miles (from the junction of U.S. Highway 191). Distance along the railroad spur to the potash site, starting from the road west of the tailings pile that goes to the railroad tunnel entrance, is much shorter at 8.4 miles. The elevation at the proposed disposal area is about 4,000 feet, the same as at the Moab millsite. Elevation difference along the railroad varies from about 4,220 feet at the north end of the tunnel (west of the Moab millsite) to approximately 3,950 feet about 0.5 mile north of the potash site.

A 3,500-foot thickness is estimated for the Paradox Formation in the proposed disposal area (Figure 5) where the formation consists of cyclically interbedded evaporite and clastic beds; 29 cycles of paired evaporite and clastic sequences have been identified. These evaporite/clastic beds are expected to be distinct and underformed or only slightly deformed.

The six solution-mined caverns, spaced approximately 1,000 feet apart, could be situated (in the subsurface) in the low, amphitheatre-like area extending from the railroad westward for about 0.75 mile (Figure 4). The top of the Paradox Formation in this area is at a depth of about 2,500 feet. The top of each cavern would be well within the Paradox at a depth of about 3,500 feet. The base of the 2,000-foot-high caverns would then be at a depth of about 5,500 feet (Figure 5).

Brine disposal at the potash site would be through deep well injection into the Leadville Limestone, estimated to be about 400 feet thick in this area and/or send to large multiple evaporation ponds about 500 acres in size. The depth to the top of the Leadville is approximately 6,500 feet at its shallowest point (where the surface elevation in the area is lowest). Depths for injection could range to about 8,000 feet.



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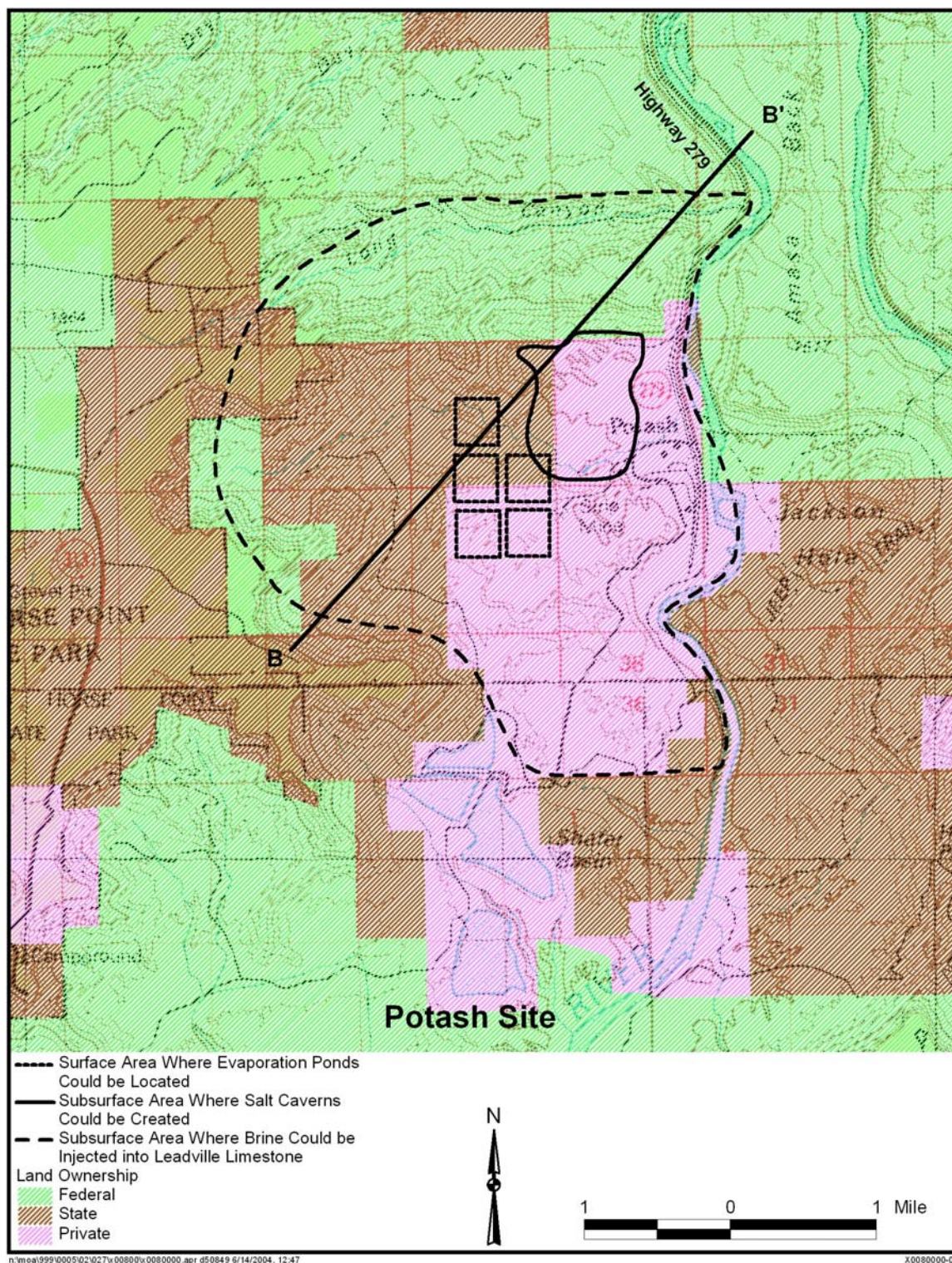


Figure 4. Property Ownership and Location of the Geologic Cross Section for the Potash Site





## **Attachment 1**

### **Description of the Sevenmile Canyon Site**

The greatly thickened section of Paradox Formation underlying the Sevenmile Canyon area could provide solution-mined caverns for tailings disposal. This area is at the mouth of Sevenmile Canyon, south of the junction of U.S. Highway 191 and State Highway 313 (Figure 6), approximately 7 miles northwest of the Moab millsite. Elevation of this area is approximately 4,500 feet; U.S. Highway 191 rises northwest through Moab Canyon to about 4,600 feet en route to this area from the millsite, which is at an elevation of about 4,000 feet.

The Sevenmile Canyon area is 0.5 to 1.5 miles southwest (on the upthrown side) of the northwest-striking Moab normal fault, which has approximately 3,000 feet of displacement (Figure 7). In this area southwest of the Moab Fault where beds dip gently to the southwest, the Paradox Formation is estimated to be as much as 7,000 feet thick. Because this area is northwest of the Moab Valley salt diapir, original evaporite beds in the Paradox Formation are expected to be distinct and underformed or only slightly deformed.

Spaced approximately 1,000 feet apart, six solution-mined caverns could be situated (in the subsurface) in the flat area south of the junction of the two highways. Here, the top of the Paradox Formation is at a depth of approximately 2,500 feet. The caverns would be situated below any cap rock that might occur in the uppermost Paradox Formation, and the top of each cavern would be at a depth of about 4,500 feet. The base of the 2,000-foot-high caverns would be at a depth of about 6,500 feet (Figure 7).

Brine disposal at the Sevenmile Canyon area would be through deep well injection into the Leadville Limestone or large multiple evaporation ponds approximately 500 acres in size. The depth to the top of the approximately 500-foot-thick Leadville Limestone in this area is about 8,000 feet.

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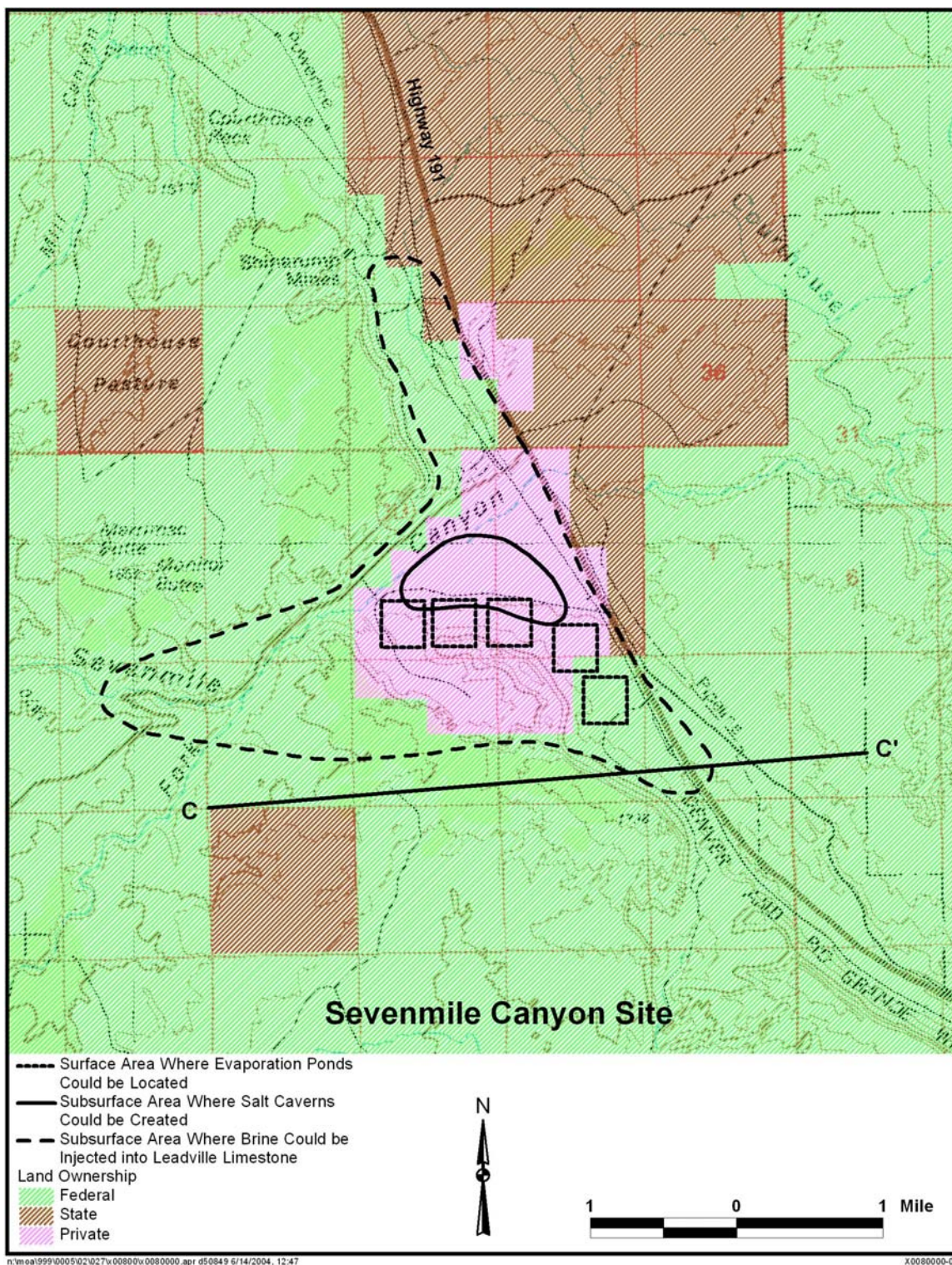


Figure 6. Property Ownership and Location of the Geologic Cross Section for the Sevenmile Canyon Site



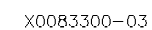


Figure 7. Geologic Cross Section for the Sevenmile Canyon Site